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(54) Flowmeters using electric switches

(57) A flow meter, especially for remote use, has a metering device 13 including at least three switches, for example reed switches 6, 7 8 and an element (14) carrying a magnet (15) rotated by the fluid flow. The rate and sequence of switching of the switches give the flow rate and direction respectively. Each switch is connected to one terminal of a respective impedance (1, 2, 3) and also to a common electrical link G. Faults may be detected by a control unit 11 which monitors the conditions at the terminals. In certain preset conditions an alarm may be generated. Arrangements may also provide to monitor the meter for mechanical and/or magnetic tampering. Instead of magnetic switches, optical switching may be used.

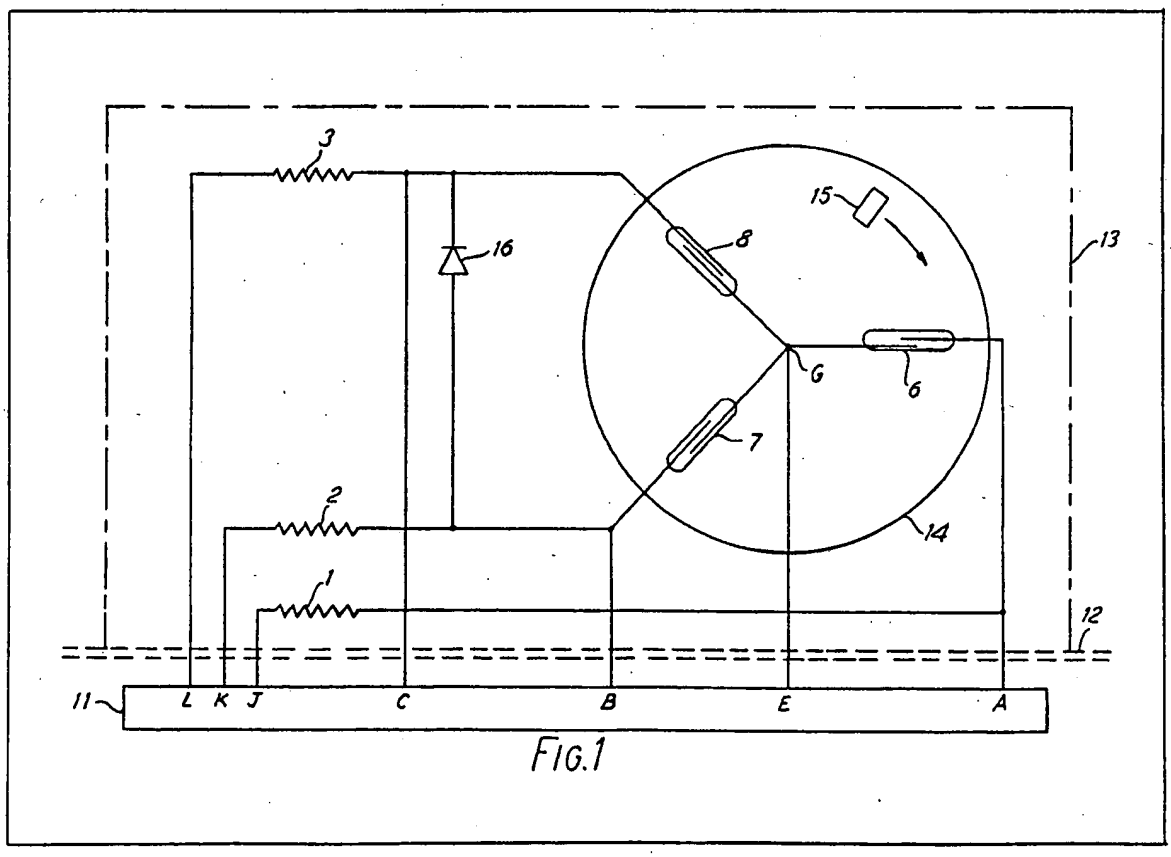

FIG.1

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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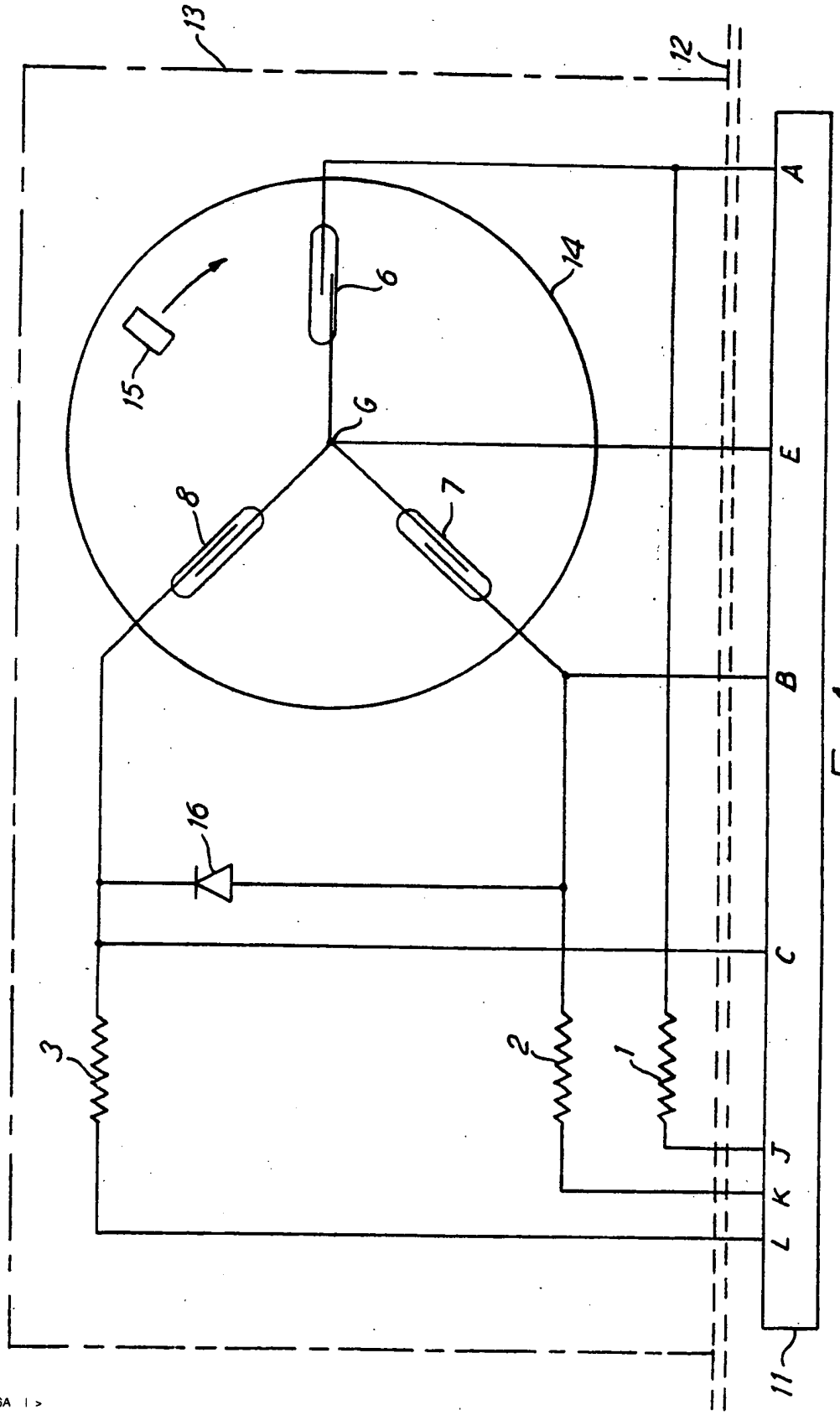

FIG.1

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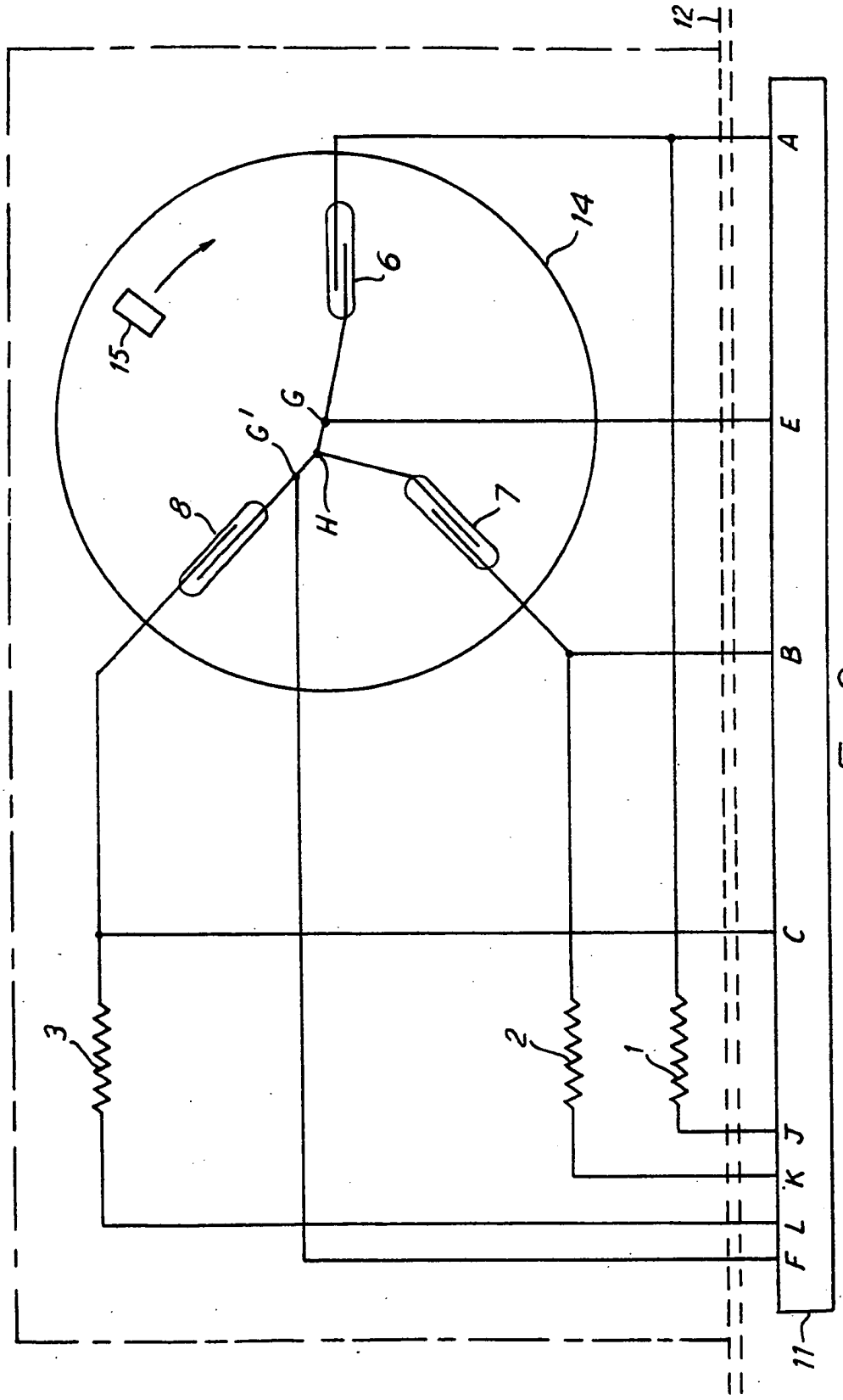

FIG.2

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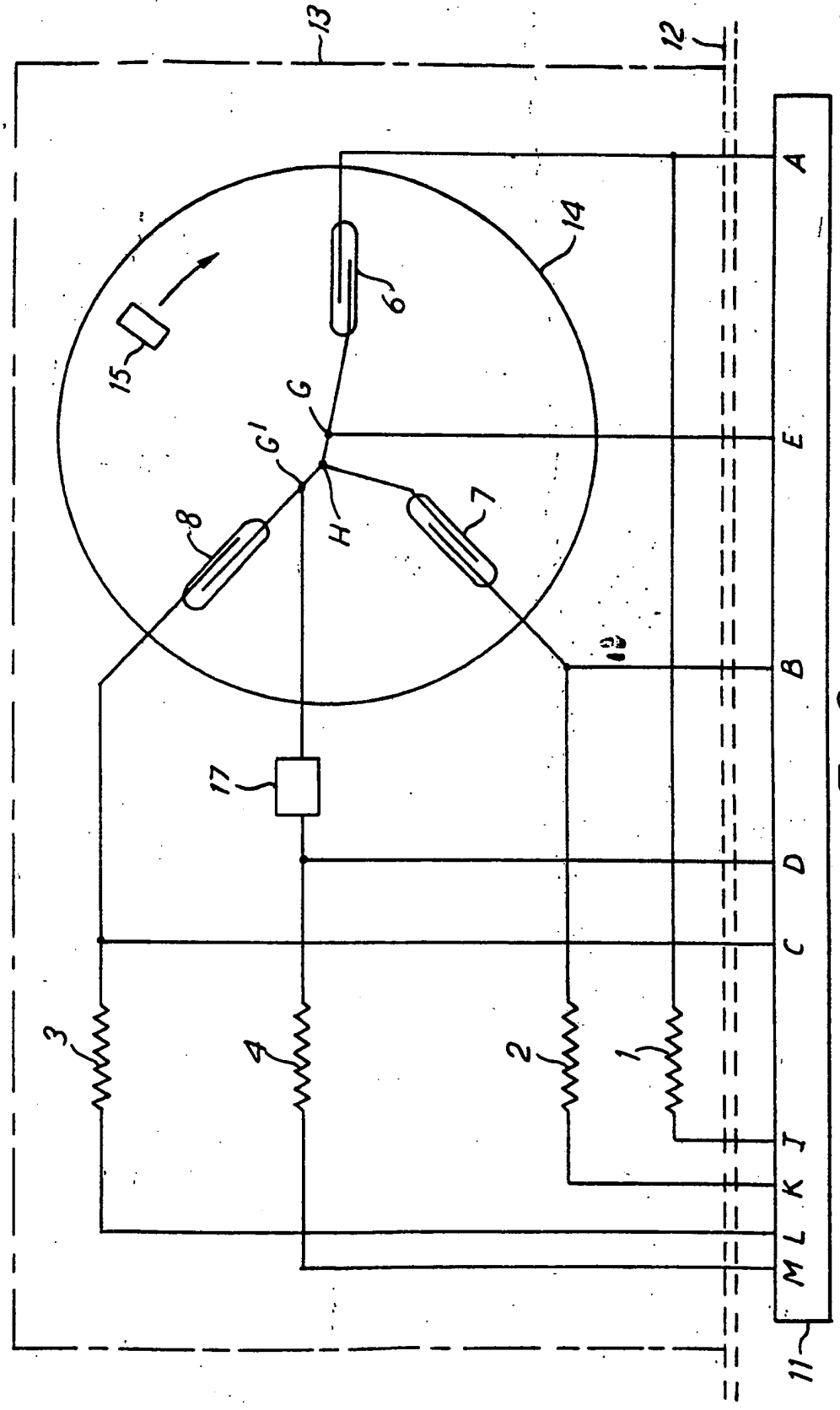

FIG.3

SPECIFICATION

Improvements relating to flow meters

This invention relates to flow meters and more especially, although not exclusively to remote utilization thereof.

Flow of a substance past a defined point may be measured by a flow meter monitoring volume flow or flow rate. Monitoring of volume flow is of particular use with respect to sensing substance consumption, as for example gas flow meters. It is desirable to also monitor the meter status having regard to faults and tampering. By utilization of remote sensing from a control point for example, volume flow may be monitored without recourse to consumer intervention and the additional aspect of meter status may be checked.

Typically volume flow and meter status are mechanically indicated and consequently this mechanical indication requires translation into a suitable electronic format to allow transmission of data to a control point. British Specification No. 1272381 discloses a flow meter, which includes an array of magnets disposed on a 10 digit mechanical dial being responsive to volume flow. An array of complementary reed switch circuits monitor the dial position by interaction with the magnets thereon. Clearly considerable numbers of reed switches and magnets are required. Furthermore, sensing of meter faults or meter tampering is not provided for.

It is an object of this invention to provide a flow meter adapted to permit remote sensing of meter faults of meter tampering, and to permit remote sensing of volume flow which is substantially unaffected by single faults in the meter.

According to one aspect of the invention there is provided a flow meter arrangement comprising a central control unit and a metering device, the metering device including at least three switching means each having a first and a second terminal, the first terminal of said switching means being connected to a first terminal of respective impedances and to respective inputs of said control unit, the second terminal of said switching means being connected to a common electrical link; the arrangement also including a voltage supply connected firstly to a second terminal of each said impedances and secondly by at least one return connection to said common electrical link; the device further including a flow driven element adapted to switch said switching means in succession when in use.

In a preferred embodiment at least two return connections are utilized and they are connected to the common electrical link at different locations thereon. Additionally one of the return connections includes a orientation sensitive device, for example a tilt switch.

In a further embodiment the voltage supply is integral with the central control unit, which is connected to the metering device via plug and socket means.

For a better understanding of the present invention and to show how it may be carried into effect, reference will now be made by way of example only, to the accompanying drawings, in which:—

Figure 1 illustrates a flow meter arrangement in accordance with one aspect of the invention,

Figure 2 illustrates an improved flow meter arrangement utilizing dual return connections,

Figure 3 illustrates a dual return connection flow meter arrangement wherein one return includes a tilt switch.

A flow meter arrangement suitable for gas for example, as illustrated in Figure 1, comprises a central control unit 11 connected through any suitable plug and socket means 12 to a metering device 13. Within the metering device there is provided a flow driven element 14, for example a rotation element, which rotation is a direct representation of gas flow in a pipe (not shown) to which the element 14 is linked. A magnet 15 disposed on this element describes an annular path, on which path three reed switches 6, 7 and 8, are located. The reed switches are firstly located to ensure that passage of the magnet operates the switches and are secondly distributed evenly around the axis of rotation of the element 14, preferably without hysteresis overlap.

A first terminal of each reed switch 6, 7 and 8 is connected to a first terminal of respective impedances 1, 2 and 3 and to respective inputs A, B and C of central control unit 11. The impedances are illustrated as resistances. A second terminal of the three resistances 1, 2 and 3 are each connected to respective terminals J, K and L of the control unit. Finally a second terminal of each reed switch is connected to a common point G to form a common electrical link, which link is connected by a return connection to a terminal E of the control unit.

It will be apparent that if a voltage is applied across terminals J, K, L and terminal E by a voltage source which may comprise a part of the control unit 11, the voltages appearing at inputs A, B and C will reflect the status of respective reed switches 6, 7 and 8. if a high voltage is applied to terminal J, K, L relative to terminal E, that is to say terminal E is earthed, then revolution of the magnet 15 will close reed switches 6, 7 and 8 in succession producing a lower voltage at the inputs A, B and C relative to the voltage produced when switches 6, 7 and 8 are open. It will be apparent that the situation is reversed if the high voltage is applied to terminal E.

The control unit can examine the succession of states of inputs A, B and C and determine, firstly the number of rotations of the element 14—relating this to flow volume, and secondly determine the direction of rotation, so that correct operation of the meter in this respect can be monitored. Values of the volume flow measurement can be transmitted by suitable transmission means (not shown) to a central point or collection station.

If a single fault occurs within the metering device apart from point G and mechanical faults,

then if for example a reed switch breaks, the function of measuring volume flow is maintained and the fault can b detected by the control unit 11 as a consequence of irregularities in input A, B and C conditions and the fault state transmitted as described hereinbefore. Furthermore if, for example, the device were subjected to a magnetic field of high strength, this would result in all reed switches 6, 7 and 8 closing to produce low inputs A, B and C, which will be indicative of this situation and an alarm may be transmitted as above. Counting of gas consumption can not be continued in this case.

Finally, it is necessary to monitor whether the metering device 13 has been disconnected from control unit 11, that is to say, the continuity of plug and socket arrangement 12 must be examined. At a suitable position in the rotation of element 14, when inputs A, B and C are not low or when it is evident minimal rotation is occurring, a reverse voltage pulse may be applied to terminal L. As a consequence of a diode 16 connected across first terminals of switch 7 and 8 this results in a low input C and a low input B if the plug and socket arrangement is in order, otherwise a socket fault condition may be transmitted.

Clearly a fault in the return connection between point G and terminal E will disrupt counting of gas consumption. Figure 2 illustrates how the effects of such a fault can be overcome by incorporating a second return connection. The numerals in this figure follow substantially those of Figure 1. It can be seen that the second terminals of reed switch 6, 7 and 8 are linked to a point H thus forming a common electrical link. A return connection from a point G on the common link is still connected to earth terminal E of the control unit 11, but there is also an additional link between a further point G' on the common link and a further terminal F on the control unit 11, which may also be earthed. The function of this meter arrangement is substantially the same as disclosed hereinabove, except that now any single electrical fault within the metering device 13 cannot prevent counting of rotations being monitored. Additionally continuity between terminals E and F may be tested to examine the plug and socket arrangement, thereby eliminating the necessity for the provision of diode 16 between the first terminals of reed switches 7 and 8.

Direction of rotation may be detected by monitoring the order of low states of inputs A, B and C as before.

In a further development, as shown in Figure 3, the return connection from point G' is connected to a terminal M through a series linked tilt switch 17 and resistor 4. The link between these two components being also connected to an input D of the control unit. Application of a voltage to terminal M which is high relative to earth produces a low voltage at input D, indicating the tilt switch 17 is in order and hence no physical tilting movement of the meter arrangement has occurred. If tilt switch 17 is interrupted then this produces a high input D indicating physical movement and this information may be transmitted as described hereinabove. Additionally, should input D become high it may be indicative of a fault in the return connection between point G and terminal E. Therefore terminal M may be in this case switched to earth by control unit 11 and provided resistance 4 is arranged to be sufficiently small compared with resistances 1, 2 and 3, then the connection between point G' and terminal M provides a second return connection allowing normal function of the metering device 13. Naturally an indication of this fault may be transmitted as above.

Therefore the flow metering device of the invention may convert by suitable means mechanical indications of flow into an electrical format for transmission and can continue to do so substantially unaffected by a single fault in said means. Furthermore, it may monitor flow direction and physical tampering and magnetic tampering to the meter arrangement. Indeed by measuring the rate of change of status of the central control with inputs, a flow rate could be isolated.

It will be apparent that the flow metering arrangement of the invention may include at least three reed switches, and indeed need not be confined to reed switches, for example suitable optical switching means could be used. Also the angular distribution of the switches about the axis of rotation of rotation element 14 may be varied and may be arranged to have overlapping hysteresis to produce further rotation direction checks and fault analysis. The detailed construction of the central control unit will be apparent to those skilled in the art and need not be described herein.

It will be understood that the embodiment illustrated shows an application of the invention in one form only for the purposes of illustration. In practice the invention may be applied to many different configurations, the detailed embodiments being straightforward to those skilled in the art to implement.

CLAIMS

1. A flow meter arrangement comprising a central control unit and a metering device, the metering device including at least three switching means each having a first and a second terminal, the first terminal of said switching means being connected to a first terminal of respective impedances and to respective inputs of said control unit, the second terminal of said switching means being connected to a common electrical link; the arrangement also including a voltage supply connected firstly to a second terminal of each said respective impedances and secondly by at least one return connection to said common electrical link; the device further including a flow driven element adapted to switch said switching means in succession when in us .

2. An arrangement according to Claim 1, wherein at least two return connections are connected to said common electrical link at

different locations on said link.

3. An arrangement according to Claim 1 or Claim 2, wherein the voltage supply is integral with said central control unit.

4. An arrangement according to any one of Claims 1, 2 or 3, wherein one of said return connections includes an orientation sensitive switching means.

5. An arrangement according to Claim 4, where said orientation sensitive switching means comprises a tilt switch.

6. An arrangement according to any preceding claim, wherein central control unit connections to said metering devic are via plug and socket means.

7. An arrang ment according to any prec ding claim, wherein the switching means comprise magnetically operated reed switches.

8. An arrangement according to any prec ding claim, wherein the switching means comprise optically operated switches.

9. An arrangement substantially as described herein, with reference to and as illustrated in the accompanying drawings.

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